Christopher Balzer

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Education

Ph.D. and M.S., Chemical Engineering

California Institute of Technology 2018–2023
Subject Minor: Applied and Computational Mathematics
Thesis: "Polyelectrolytes near Solid Surfaces"
Advisor: Prof. Zhen-Gang Wang • DOE CSGF Fellow • GPA: 4.0

M.Phil, Chemical Engineering

University of Cambridge 2017-2018
Thesis: "Computational Analysis of Metal-Organic Frameworks for Separation of CO/N_2"
Advisor: Prof. David Fairen-Jimenez

B.S.E, Chemical Engineering

Barrett, the Honors College, at Arizona State University 2014–2017
Thesis: "A Model of Nanoparticle Dispersion in Electrospun Nanofibers"
Advisor: Prof. Bin Mu • GPA: 4.0

Selected Awards and Honors

National
Frank J. Padden Jr. Award Finalist (2023)
DOE Computational Science Graduate Fellowship (2019)
Churchill Scholarship (2017)
Goldwater Scholarship (2016)
Society of Chemical Industry (SCI) Scholar (2016)

Caltech
Jacobs Translational Medicine Fellowship (2018)

Arizona State University
Outstanding Undergraduate Thesis Award (2017)
NSF Collaborative Interdisciplinary Research Community Scholarship (2015,2016)
Fulton Undergraduate Research Initiative Grant (2015,2016)

Publications

† denotes equal contribution

(16) **C. Balzer**, Z.-G. Wang, "Electroresponse of Weak Polyelectrolyte Brushes", *Eur. Phys. J. E*, 46, 82 (2023)

(15) S. Varner†, **C. Balzer**†, Z.-G. Wang, "Entropic Origin of Ionic Interactions in Polar Solvents", *J. Phys. Chem. B*, 127, 4328–4337 (2023)

(14) **C. Balzer**, A. L. Frischknecht, "Explicit Polarization in Coarse-Grained Simulations of Ionomer Melts", *Macromolecules*, 55, 9980—9989 (2022)

(13) **C. Balzer**, P. Zhang, Z.-G. Wang, "Wetting Behavior of Polyelectrolyte Complex Coacervates on Solid Surfaces", *Soft Matter*, 18, 6326–6339 (2022)

(12) D. Bruch[†], **C. Balzer**[†], Z.-G. Wang, "Thermodynamics of electrolyte solutions near charged surfaces: Constant surface charge vs constant surface potential", *Journal of Chem. Phys.*, 156, 174704 (2022)

(11) A. S. Ylitalo, **C. Balzer**, P. Zhang, Z.-G. Wang, "Electrostatic Correlations and Temperature-Dependent Dielectric Constant Can Model LCST in Polyelectrolyte Complex Coacervation", *Macromolecules*, 54, 11326–11337 (2021)

(10) N. Rampal, A. Ajenifuja, A. Tao, **C. Balzer**, M. S. Cummings, A. Evans, R. Bueno-Perez, D. J. Law, L. W. Bolton, C. Petit, F. Siperstein, M. P. Attfield, M. Jobson, P. Z. Moghadam, D. Fairen-Jimenez, "The development of a comprehensive toolbox based on multi-level, high-throughput screening of MOFS for CO/N2 separations", *Chemical Science*, 12, 12068–12081 (2021)

(9) **C. Balzer**[†], L. Qing[†], Z.-G. Wang, "Preferential Ion Adsorption in Blue Energy Applications", *ACS Sustainable Chem. Eng.*, 9, 9230–9239 (2021)

(8) **C. Balzer**[†], J. Jiang[†], R. L. Marson, V. V. Ginzburg, Z.-G. Wang, "Nonelectrostatic Adsorption of Polyelectrolytes and Mediated Interactions between Solid Surfaces", *Langmuir*, 37, 5483–5493 (2021)

(7) **C. Balzer**, R. Oktavian, M. Zandi, D. Fairen-Jimenez, P.Z. Moghadam, "Wiz: A web-based tool for interactive visualization of big data", *Patterns*, 1, 100107 (2020)

(6) V. Rana, A. Tabet, J. Vigil, **C. J. Balzer**, A. Narkevicius, J. Finlay, C. Hallou, D. Rowitch, H. Bulstrode, O. Scherman, "Cucurbit[8]uril-Derived Graphene Hydrogels", *ACS Macro Letters*, 8, 1629–1634 (2019)

(5) **C. Balzer**, M. Armstrong, B. Shan, Y. Huang, J. Liu, and B. Mu, "Modeling Nanoparticle Dispersion in Electrospun Nanofibers", *Langmuir*, 34, 1340–1346 (2018)

(4) M. Armstrong. **C. Balzer**, B. Shan and B. Mu, "Influence of particle size and loading on particle accessibility in electrospun poly(ethylene oxide) and ZIF-8 composite fibers: experiments and theory", *Langmuir*, 33, 9066–9072 (2017)

(3) **C. J. Balzer**, M. R. Armstrong, B. Shan and B. Mu, "Composite MOF Mixture as Volatile Organic Compound Sensor - A New Approach to LMOF Sensors", *Materials Letters*, 190, 33–36 (2017)

(2) M. R. Armstrong, S. Senthilnathan, **C. J. Balzer**, B. Shan and B. Mu, "Particle size studies to reveal crystallization mechanisms of the metal organic framework HKUST-1 during sonochemical synthesis", *Ultrason. Sonochem.*, 34, 365–370 (2017)

(1) M. R. Armstrong, K.Y. Yuriar Arredondo, C.-Y. Liu, J. E. Stevens, A. Mayhob, B. Shan, S. Senthilnathan, **C. J. Balzer**, and B. Mu, "UiO-66 MOF and poly (vinyl cinnamate) nanofiber composite membranes synthesized by a facile three-stage process", *Ind. Eng. Chem. Res.*, 54, 12386–12392 (2015)

Research experience

UC Santa Barbara

Field-theoretic Simulations of Classical and Quantum Fluids 2023 – Present
Advisor: Prof. Glenn Fredrickson
Developing computational and field-theoretic methods to study complex classical and quantum fluids. Current focus is the phase behavior of reversibly associating networks using coherent states field theory.

Caltech

Simulation and Theory of Inhomogeneous Polyelectrolytes 2018–2023
Advisor: Prof. Zhen-Gang Wang
Developed thermodynamics of polyelectrolyte solutions and interfacial phenomena, especially near solid surfaces. Approaches range from field-based self consistent theory or classical density functional theory to coarse-grained molecular dynamics simulations.

Sandia National Laboratories

Coarse-Grained Simulation of Ionomer Melts Summer 2021
As part of DOE Computational Science Graduate Fellowship practicum
Advisor: Dr. Amalie Frischknecht
Created a molecular dynamics simulation methodology to incorporate polarization (Drude oscillators) into a Kremer–Grest coarse-grained polymer model to study ion transport in ionomer melts.

University of Cambridge

Multi-scale Simulations for Gas Separations 2017–2018
Advisor: Prof. David Fairen-Jimenez
Designed and conducted high-throughput molecular and process simulations to screen metal-organic framework materials for separation of CO and N_2. Developed transferable, polarizable forcefields used in grand canonical Monte Carlo simulations for MOF subset.

W. L. Gore & Associates

Fluoropolymer Adhesives 2017
Medical Products Division • Surface Engineering Group
Mentors: Dr. Yuling Wang, Dr. Lijun Zhou
Developed a novel test method to measure adhesive strength of fluoropolymer adhesives to Nitinol wires.

Arizona State University

Metal-Organic Frameworks for Gas Separation and Sensing 2014–2017
Advisor: Prof. Bin Mu
Synthesized MOFs via solvothermal and sonochemical synthesis routes. Characterized using FT-IR, fluorimetry, XRD, and gas sorption measurements. Embedded MOF materials into polymer nanofibers via electrospinning for mixed-matrix membranes.

Contributed Presentations

(13) Center for Polymers and Organic Solids (UCSB), Oral (invited), “Theory of Sequenced Supramolecular Polymers”, March 2024

(12) Complex Fluid Design Consortium (UCSB), Oral, “Sequence Effects in the Thermodynamics of Supramolecular Polymers”, January 2024

(11) DOE Computational Science Graduate Fellowship Annual Review, Oral, "Unraveling Electrostatic Interactions in Polar Solvents", July 2023

(10) APS March Meeting 2023, Oral (invited), "Electrostatic Manipulation of Weak Polyelectrolyte Brushes"

(9) AIChE Annual Meeting, Oral, "Complex Coacervation in Polyelectrolyte Brushes", November 2022

(8) Polymer Physics Gordon Research Conference, Poster, "Explicit Polarization in Coarse-Grained Simulations of Ionomer Melts", July 2022

(7) Polymer Physics Gordon Research Seminar, Oral (invited), "Explicit Polarization in Coarse-Grained Simulations of Ionomer Melts", July 2022

(6) DOE Computational Science Graduate Fellowship Annual Review, Poster, "Structure and Dynamics of Ion Aggregates in Simulations of Ionomer Melts", July 2022

(5) APS March Meeting 2022, Oral, "Wetting and Contact Angles of Complex Coacervates"

(4) APS March Meeting 2021, Oral, "Wetting Behavior of Complex Coacervates"

(3) AIChE Annual Meeting, Virtual, Oral (invited session), "Interactions between Surfaces Mediated By Polyelectrolyte Dispersants", November 2020

(2) AIChE Annual Student Conference, Poster, "Composite MOF Mixture as Volatile Organic Compound Sensor", November 2016

(1) AIChE Rocky Mountain Regional Student Meeting, Poster, "Kinetic Study of Sonofragmentation of Metal-Organic Frameworks", April 2016

Teaching experience

Spring 2021 **Teaching Assistant, CHE 148: Polymer Physics (Caltech)**
Graduate level introduction to polymer physics and polymer research topics. Advised students on assignments and research proposals for the end of term project. (12 hrs/wk)

2018–2019 **RISE Tutor (Caltech)**
Volunteer tutoring of high school students in Pasadena area. (3 hrs/wk)

Spring 2017 **Teaching Assistant, CHE 442: Chemical Reactor Design (Arizona State University)**
Held office hours, led review sessions, created tutorials for numerical tools (MATLAB and Python), developed example problems related to design/kinetics of chemical reactors. (9 hrs/wk)

2015–2017 **Undergraduate Tutor (Arizona State University)**
Tutoring university level math, chemistry, physics, and relevant engineering courses at university tutoring center (25 hrs/wk)